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Contents:

Taxonomy to Support Traceability System for Smart Disclosure of Halal Product Information

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Abstract

This paper aims to depict taxonomy of Halal certification process as the beginning step in constructing ontology to support the integration of heterogeneous data points across the supply chain. This study proposes that the taxonomy would be the first step to enable two major uses, namely: integration and standardization. The resulting ontology is envisioned to support knowledge discovery and sharing by synthesizing information across disparate data sources that are valuable for informing data-driven policy formulation, in particular for Halal certification domain. The taxonomy also represents the initial effort to supports standardization of an agreed set of terms and semantics for currently fragmented Halal certification and inspection schemes. The internal consistency of the proposed taxonomy is verified by using current reasoning tools to run queries based on a set of predefined competency questions. The resulting taxonomy will provide the preliminary step to enable the provision of a tool to promote transparency and trust in certification systems.

Keywords*: Taxonomy, Online traceability, Halal certification, Indonesia.*

1. Introduction

Nowadays, it is not easy for consumers to ascertain that their product purchase aligns with their belief and values, due primarily to information asymmetry in the market. Consumers are forced to rely on limited information available in product packaging [15]. Consequently, to ascertain maximum utility of their buying decision, consumers are increasingly relying on product certification, including Halal certification and label. Trust on certification and label become crucial for buying decision [13], more so for Halal certification where Islamic dietary laws predominantly dictate consumers' motivation to buy a product [2, 17, 18].

Notwithstanding, it becomes more and more demanding for Muslim consumers to verify that a Halal label or certificate depicted on a product package can be trusted [18]. Supply chain becomes lengthy and complex where products come from global sources and verifying product information becomes expensive [13]. Not to mention that some information needed to verify the trustworthiness of Halal certification only visible after a close examination of the internal processes used in producing and handling of a given product and are made available by tracing the provenance of information along the supply chain [11].

In addition, efforts to use Halal certification to promote trust on a product are challenged by the existence of various labels and certifications [22]. Consumers might very well be wary of the meaning and credibility of information provided by various labels and certifications. Worst, these Halal labels and certifications follow different standards enacted by different Halal standards from different countries (see [18], p. 112).

This situation led to many cases of dishonest use of halal certificates and/or logos by producers [10, 18]. A plausible solution is to use recent technological advancement to enable integration of heterogeneous data across many sources in the supply chain through an interoperable data architecture that is based on the application of Semantic Web technologies [20, 22]; to do so requires mapping of different concepts from various Halal certification. This paper describes our preliminary efforts to construct data architecture based on ontology to support smart disclosure application for understanding

product information, particularly related to Halal certification. This paper aims to create a taxonomy of Halal certification process as the beginning step in constructing ontology to support the integration of heterogeneous data points across the supply chain.

2. Information Asymmetry and the Need for Taxonomy for Halal Certification

Information asymmetry is a crucial determinant supporting a market dynamics. Asymmetry exists when some actors in the market (typically producers) have more and better information on product quality as compare to consumer [8]. Information asymmetry incentivizes producers to use the price mechanism to offer low-quality products to consumers and drive out-high quality product from the market [1]. This situation creates negative externalities in which price did not actually represent all necessary costs to bring a product to the market, such as the use of dangerous components in the product, pollution, sub-optimal working conditions and others. Information asymmetry restricts the ability of consumers to maximize the utility of their purchasing decision in accordance with their believed values and norms, including religious values.

One mechanism to govern information asymmetry is through private regulation. Private regulation is designed to use market pressure to regulate the behavior of industry's actors [3, 12] and to add layers to the existing laws, regulations, and standards enacted by the government [4]. Private regulation takes many forms and one of them is a certification system. A certification system that is typically delivered by a third-party generally involves an evaluation of product or production process conformance to sets of standard, from the point of production to the point of retail. There are two important factors to consider in certification: a) the trustworthiness of a certification body and b) the conformance of producers to the certification standards [13].

Among the various types of certification, Halal certification is a certification system with emphasize on the conformance to sets of a standard developed in accordance with Islamic law, principles, and values [16]. Consequently, Muslim consumers' conformance to a Halal dietary law is binding and as result trust to Halal certification is magnified by the devotion to their religious belief. Per se, product packaging that endorses Halal principles by depicting Halal logo increases Muslim consumer's motivation to buy the product [17].

Once, Muslim consumers simply ignored product with no depiction of a Halal logo as this product is deemed to be not conformed to Halal principles [17]. Unfortunately, trust to Halal certification become more difficult for Muslim consumers to ascertain [18]. There are cases of dishonest use of halal certificates and/or logos due to in part the variety of halal certifications and logos [10, 18], mixed of Halal and Haram components in the manufacturing process, the lengthening and complexity of supply chain, and the use of various ingredients from various different sources [18]. As result, these cases undermine the value of Halal certification and ascertaining trustworthiness becomes difficult and expensive to do.

One plausible proposed solution to improve trust on Halal certificate and logo is by creating visibility through the supply chain, feasibly through traceability of information along the supply chain. Halal certification is obliged to demonstrate that production process conforms to Islamic law and principles [18]. Muslim consumers are increasingly demanding more disclosure of information of a product to ensure their purchasing decision [17].

A new approach by altering the consumers' choice architecture through smart disclosure could enhance the utility of certification, including halal, to help consumer making choices that fit with their belief system and values [19, 22]. This approach that partially stems from recent technological development provides consumers with timely and relevant data in standardized and machine-readable formats in smart disclosure tools could enable comparability across

different certification schemes which in turn allow for an assessment of the credibility, quality, and legitimacy of the certification [20].

The key is to enable the integration of heterogeneous data across many sources in the supply chain through an interoperable data architecture that is based on the application of Semantic Web technologies [20, 22]. Semantic web technology offers flexibility and expansiveness in integrating various data since it "takes an overlay approach that virtualizes information from existing (non-semantic) source systems, imports that information into the Semantic Web data model, and then links together information between various connected systems [5]". The key utility of semantic technology is the ability to capture data in ontologies and map them via related concepts [21] and the first step is to create a taxonomy of the certification.

3. Methods

We utilize two methods in our modeling approach: a) methods to collect the data to support the development of the taxonomy and b) methods to build the taxonomy. This section briefly discusses these methods.

3.1. Data Collection Methods

We use a combination of interviews and document analysis to collect the data in order to understand the domain, extract concepts and create motivating scenarios and competency questions. A detailed explanation of our data collection methods is as follow.

- Interviews. We conducted interviews with experts in Halal certification and experts in Islamic principles governing Halal.
- Document analysis. We conducted document analysis examining the documents published by Halal standard bodies, particularly MUI (Majelis Ulama Indonesia) as well as certification bodies listed on the list of approved foreign halal certification bodies from MUI such as: Halal Food Council USA (http://www.halalfoundation.org); Halal certification council (http://www.halal-australia.com.au) and IFANCA (Islamic Food and Nutrition Council of America / http://www.ifanca.org). Examining the documents enable us to extract important concepts and terms in Halal certification and inspection, as well as understanding the relationship among them.

3.2. Methods for Building the Taxonomy

Our methodology for building the taxonomy follows an iterative life-cycle approach adapted from commonly used ontology-development methods including the METHONTOLOGY [9], the 101 Method [14], and an ontology-development process for developing government ontology [6]. The ontology development life cycle proposed in the above-mentioned studies includes three phases – specification, conceptualization, and implementation and verification.

- The specification phase focuses on understanding the domain to define the scope and limits of the ontology.
- The conceptualization phase involves identification of classes, relations, attributes, and instances to conceptualize the ontology.
- The implementation and verification phase. This stage involves the efforts to implement and verify our proposed ontology. We used Protégé 4.1 as the tool to implement the ontology. We ran the reasoning embedded in protégé, in particular, Hermit ++ and Pellet to verify the consistency of our ontology.

The above three-phase procedure is an iterative process. As shown in figure 1, the problems and issues that we found in the implementation and verification phase helped us to re-define the scope of the ontology and re-specify the ontology.

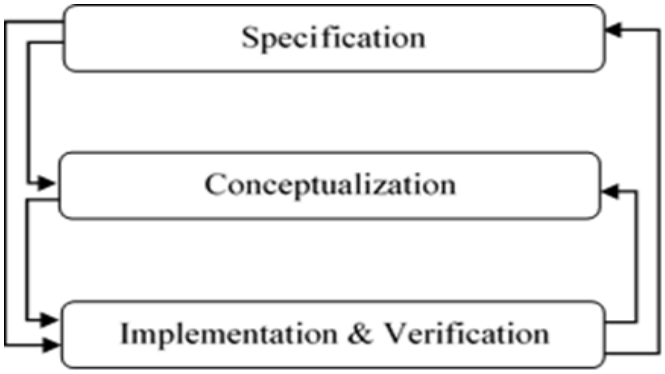

Figure 1 Three-phase Ontology Development Process (adapted from [9])

4. Results and Findings

4.1. Overview of Halal Certification Processes

Halal certification is applicable to all companies in a product supply chain, from the producers (farmers, crafter, etc) to retailer. In general, the certification processes consist of processes to evaluate: documents and a visit to the Applicant's production site. Ideally, each stakeholder in the supply chain obtained a Halal certificate to ensure that each product manufactured by each company went through production processes that are adhered to the Sharia principles. In the case of Indonesia, the scope of Halal certification includes raw materials, products, and processes.

The processes for Halal certification in Indonesia consists of 8 related steps. The first process is related to the necessity for the Applicant to understand the requirements for Halal certification and to attend training about Halal Guarantee System (HGS). This process is followed by the condition that the Applicant must implement the HGS in their company. Subsequently, the Applicant must prepare all the necessary documentation for Halal certification. The Applicant then registers for Halal Certification and uploading their data. After upload and registration, the Application will pay the fees. At the same time, the certification agency will conduct a pre-audit monitoring of the documents submitted by the application. Following this process, the certification agency will audit and conduct a site visit to the Applicant's production site. After an audit, the certification agency will conduct monitoring post-audit. Once, the certification agency is satisfied with the post-audit monitoring, the Halal certificate will be granted to the Applicant.

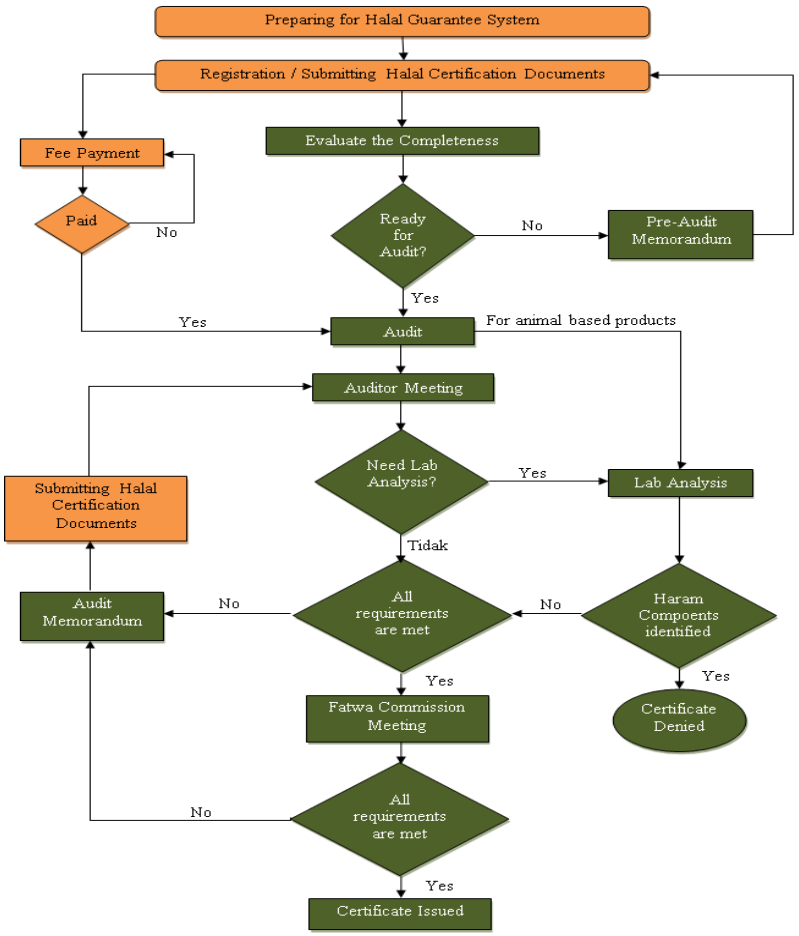

Figure 2. Halal Certification Processes in Indonesia

4.2. Taxonomy of Halal Certification Processes

Taxonomy describes the hierarchical category forming a certain concept. In our preliminary taxonomy, we only represent the Halal certification in the highest level of abstraction. The taxonomy will subsequently be developed into an ontology. We envisioned in our next work, an integrated global ontology. An integrated global ontology provides a shared vocabulary by which all local ontologies are connected to it [6]. Thus our envisioned ontology will describe the higher level definition of the Halal certification system that serves as an overarching architecture to connect detail ontology for Halal certification and labeling from various different standard and certification bodies.

Table 1. Classes and Sub-Classes in Halal Taxonomy

Class	Sub-Class
Agent	*Applicant*
	Certifier
	Inspector
	CertifyingOfficer
	StandardSetter
Document	*Certificate*
	InspectionReport
	Standard

Inspection Process in Certification	*DocumentInspection*
	FieldInspection
Evaluation Decision	*Corrective Measure*
	NonConformity
	ObjectiveEvidence
Object of Certification	*BusinessEntity*
	Process
	ProductOrService

Our proposed taxonomy consists of five major components, namely: agent, document, an object of certification, Inspection process in certification, and evaluation decision (table 1) The Protégé snapshot of the Halal Taxonomy is presented in Figure 3 and the relationship among the classes for Halal taxonomy is presented in Figure 4 below.

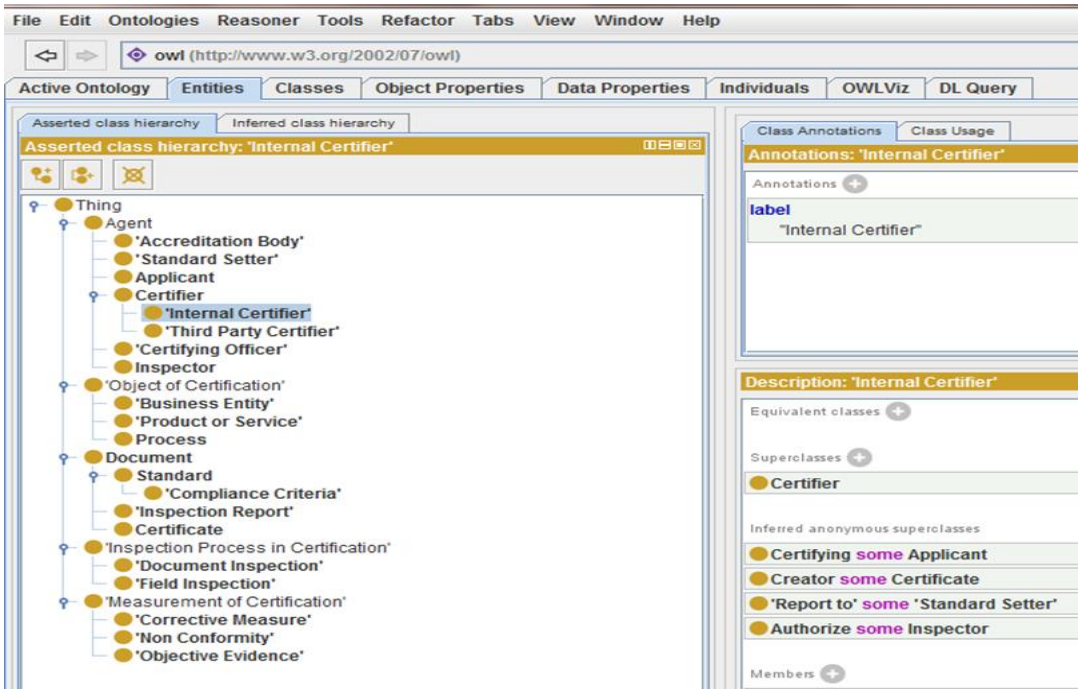

Figure 3. Snapshott of the Taxonomy in Protege

1. **Agent** refers to entities involved in the process of certification. An agent can be an individual or an organization. Agent has different roles in a Halal certification system. The agent involved in Halal certification consists of five entities, namely: applicant, certifier, certifying officer, auditor, and standard setter.
2. **Document** refers to the key documents that are used in or are produced as an outcome of the certification and inspection process. There are three major documents, a) a certificate to represent the outcome of a certification process, b) audit report to represent the result of an inspection, and c) Halal standards and compliance criteria, which are the principles that guide the Halal certification process.
3. **Object of certification** refers to the object applicable for certification. These objects are the focus of Halal certification and inspection. Although in recent there is only one object which is products, we envisioned the possibilities of three objects, namely: products, processes, and business entities.
4. **Inspection process in certification** refers to the process of gathering evidence to assess the compliance of an applicant or object of certification with the standard and compliance

criteria set by the certifier and standard body, for example, MUI Fatwa council. There are two types of inspection: document inspection and field inspection.

5. **Evaluation decision** refers to the criteria to be met in order to assign an evaluation decision as a result of the inspection process. The evaluation decision is based on the applicant's conformance to the certification standard and criteria. Consequently, the evaluation decision criteria refer to the applicant's non-conformity to the standard, based on objective evidence encountered during the inspection, along with an action required (corrective measure) to remedy the non-conformity. Evaluation decision consists of three classes, namely: non-conformity, a corrective measure, and objective evidence.

To define the relationship among the classes, each rectangle in Figure 4 represents a class. Arrows between classes are annotated by property names and represent object properties which define the relationship between classes.

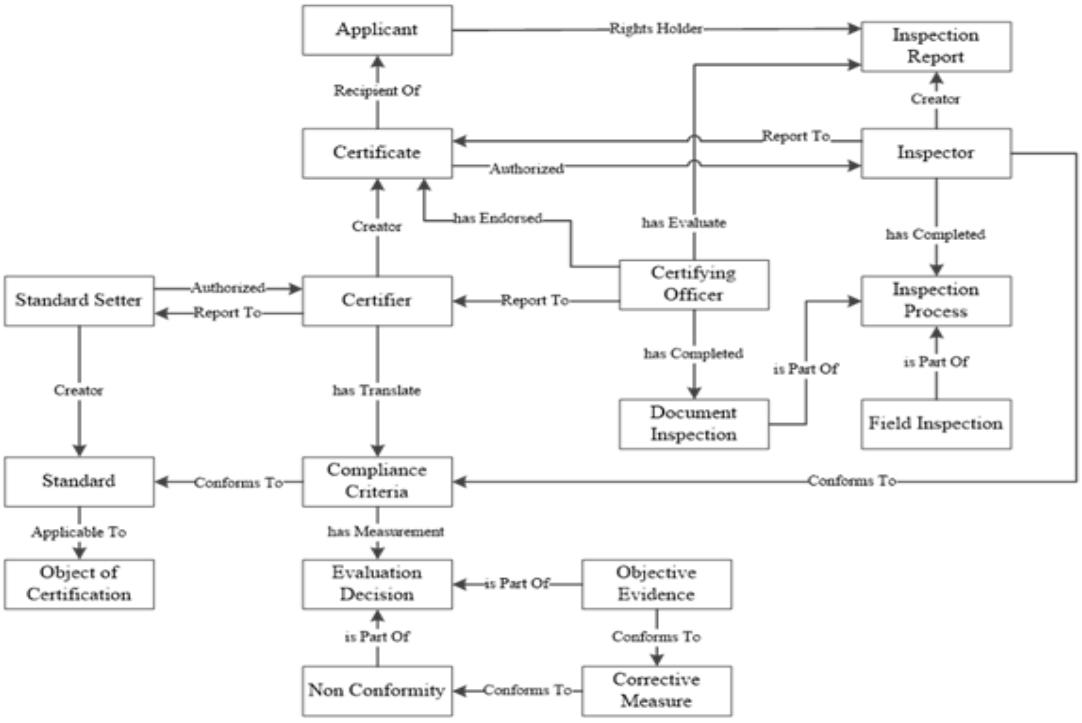

Figure 4. Relationships among the Classes

Each arrow can be read as a triple <*ClassX propertyName ClassY*>. For instance, the relationship between applicant and inspection report in Figure 3 can be represented as: <*Applicant* rightHolders *InspectionReport*>, meaning, the applicant is the right holders of an inspection report.

We further verified the resulting taxonomy using the embedded DL query in Protege, particularly based on Hermit ++. We conducted the query based on the parameter that defines a particular class. For instance, "complied to" Standard. If we run this query, the result should be Applicant and Inspector, because both of the agents must conform and comply with the Halal certification standard. Based on the query result in Protege (Figure 5), we obtain the consistent result thus indicating the internal consistency of the taxonomy.

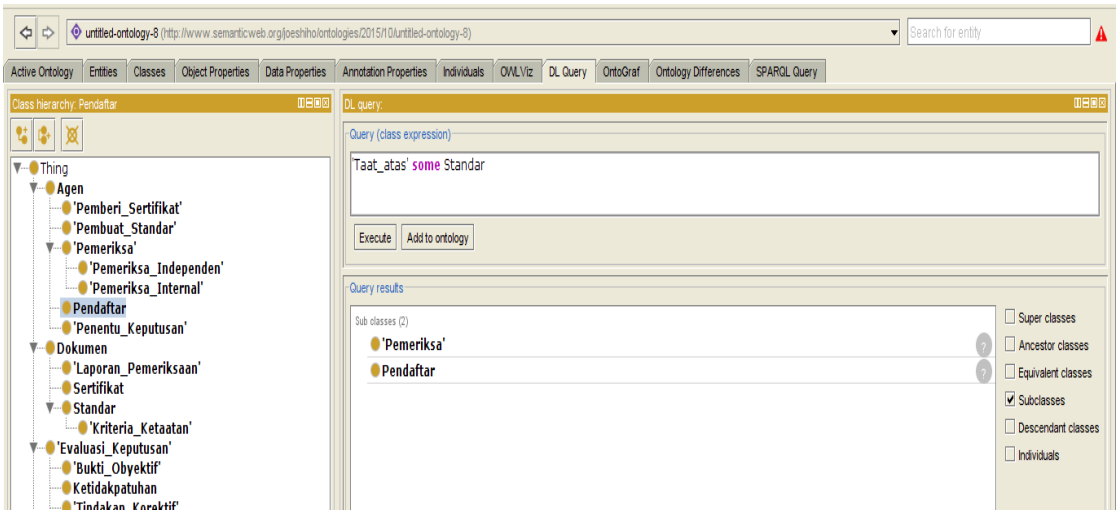

Figure 5. DL Query for Verifying the Internal Consistency of the Taxonomy

5. Conclusion

This paper presents the development of certification and inspection taxonomy to support smart disclosure of product information. The taxonomy is the initial pathway to construct an ontology-based data architecture that enables information integration and standardization thus supporting knowledge discovery and sharing by synthesizing information across disparate data sources that is valuable for informing data-driven policy formulation. The taxonomy also represents the first effort to supports standardization of an agreed set of terms and semantics for currently fragmented certification and inspection schemes to support comparability across different certification schemes. Based on documents analysis and interview findings, we propose a taxonomy for Halal certification systems consisting of five major components: agent, document, the object of certification, inspection process in certification, and evaluation decision. We created instances (individual) in our taxonomy and run the reasoned using Hermit ++ to further evaluate the consistency of our taxonomy. The inclusion of instances in our ontology did not create any inconsistencies between classes. We posit that the proposed taxonomy could provide the beginning effort to support standardization of an agreed set of terms and semantics for currently fragmented certification and inspection schemes and allow comparability across these schemes.

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2017 Article

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Keyword

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